GEOTECH
CONSULTANTS, INC.

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March 10, 2005

JN 05026

Ethan Construction, LLC
3100 Airport Way South
Seattle, Washington 98134

Attention: John Jack

Subject: **Review of Plans and Stability Analysis**
Proposed Fire Road at the Existing Rainier Commons Complex
3100 Airport Way South
Seattle, Washington

Dear Mr. Jack:

We have completed a general review of the geotechnical aspects of the plans and specifications for the proposed fire road to be constructed at Rainier Commons Complex in Seattle. The plans we reviewed included Sheets 1 through 9. Site Development Services prepared these plans, which are dated March 10, 2005. We completed a geotechnical engineering study for this site dated February 3, 2005. In addition to our review of the plans, we have also reviewed two Correction Notices prepared by Seattle DPD. One of the more significant recommendations raised in the Correction Notice was to perform a stability analysis for this project. That analysis is included in this letter.

One of the comments noted on one of the Correction Notices was regarding the face inclination of the block wall that will extend along much of the eastern side of the southern half of the fire road. Although block walls such as these are typically constructed with a "battered" face, that is not always necessary. For this project, the block wall has been structurally designed to have a vertical face.

Stability Analysis

A key component to a stability analysis is the soil parameters that are imputed in it. Several test pits and borings have been performed in the area of the fire road. Native soils revealed in these explorations were silt soils that were generally sandy or had a low plasticity. Two test pits found some significant amounts of fill. However, in the test pit that was excavated near Station 4+50 on the western, building-side of the fire road, it was apparent that the fill was just backfill that had been used after the basement wall of the building was constructed; the fill noted in the test pit at this location does not extend into the proposed wall and slope area to the east of the fire road (as noted in our study, an approximate 8-foot-tall, vertical excavation can be seen in this area). The other test pit where significant fill was revealed was at the western side of the fire road near Station 1+25. In that area, the excavation on the western side of the road will remove this fill. For the reasons noted above, we did not include the fill soil in our analysis because they are not involved in the block wall/slope of this project or will be removed.

Because of the mostly sandy nature of the native silt, we have generally modeled the silt as a granular soil. Based on the blow counts noted in the test borings and our observations of the soils in the test pits, we believe that the most accurate depiction of the soil is loose to medium-dense, in the test pits, we believe that the most accurate depiction of the soil is loose to medium-dense, fine sand. Using a soil correlation chart (Bowles, 1988), an internal angle of friction of approximately 32 to 33 degrees is appropriate for the native sandy silt soil. For our stability analysis, we conservatively chose to use an internal angle of friction of 32 degrees. However, based on the fact that vertical cuts of up to 10 feet were made almost 5 months ago at the site, we believe that the soil also has some apparent cohesion (without some cohesion, sandy silt soil would not be able to stand like this). For this reason, we have included a minimal cohesion of 100 psf for the soil into our analysis.

One comment noted in one of the Correction Notices was regarding modeling the soils at the site using their "residual shear strengths". In the Seattle area, most notably the I-5 corridor through downtown Seattle, open cut slopes were made into very stiff, clayey silt soils. These silt soils are over consolidated due to glaciers that compressed them. When excavations are done into these soils, the lessening of the weight can cause the silt in the excavated slopes to "rebound" and fracture along bedding planes (the clayey silts were deposited in a layered, lake environment). It was greatly experienced in the I-5 corridor, and experienced by our firm, that the excavated slopes could not stand nearly as steeply as expected even though the silt was very stiff due to "rebound fracturing". The strength of these soils was calculated after excavations had failed, and the soil was found to have internal angles of friction in the range of 13 degrees and cohesion of 50 psf, which are their residual shear strength. This shear strength is very low. It is our professional opinion that the soils we have encountered on the site should not be modeled using residual shear strength because the silt is more sandy than clayey and is not very stiff. Our firm was involved in a potential building project starting in December of 2003 near the south end of the fire road. Prior to the recent excavations in this area, we observed that he existing slope in that area was sloped overall at approximately 40 percent and has sections that are near 50 percent. It appeared as though the slope had been there a significant period of time, because it extended between the I-5 right-of-way (top of slope) to large, old towers in the Rainier Commons complex (bottom of slope). If the soils in this slope had only a residual strength, this slope could not have existed with inclinations of 40 to 50 percent. This is another reason why, in our professional opinion, that using residual strengths for the site soil is not appropriate.

No groundwater was found in the recent test pits, and none has been seen in late fall and winter this year emanating from the recent vertical cuts at the site. It has been a very mild and dry winter and maybe not a good indicator of groundwater. However, we performed the previous test borings on the southern side of the site in late December of 2003 and found no groundwater. In addition, we have obtained the drilling logs of the column piers used to support structures in the I-5 right-of-way. Although the piers were drilled to depths of 60 to 80 feet, no groundwater was noted on the logs. The piers were drilled in June of 1966. Therefore, based on evidence of the lack of groundwater where the block wall and/or excavated slopes are proposed for this project, it is our professional opinion that groundwater should not be added into the analysis.

From a geotechnical engineering standpoint, the project includes proposed 2:1 (H:V) cut slope and/or a 5-foot-tall block wall at the eastern, upslope side of the wall. The downslope western side of the road will also be below or at the existing ground. The most critical wall and slope section for this project is near Station 8+00 along the road. At that point, an approximate 20-foot-tall, 2:1 (H:V) slope is proposed above a 5-foot-tall block wall. Because this section is the most critical, it is the one used for our analysis.

In order to analyze the critical slope and wall section, we completed a slope stability analysis using WINSTABL computer program. This program was developed by Purdue University. Using a Modified Janbu analysis, and imputing the soil and groundwater parameters noted above, we analyzed the stability of the critical section under both static and dynamic (seismic) conditions. A potential peak horizontal ground acceleration of 0.4g (seismic coefficient of 0.2g) was included in the dynamic analysis. A safety factor of 1.6 and 1.3 against slope failure were revealed based on our analysis for the static and dynamic conditions. These safety factors are very adequate in our opinion. Therefore, it is our professional opinion that the proposed grading for this project, which includes the 2:1 (H:V) excavation slope and/or the 5-foot-tall block wall.

In accordance with Seattle DPD Director's Rule 3-93, the following statements are made:

> In our judgement, the plans conform to the recommendations in our geotechnical engineering report. If the recommendations and conditions of the geotechnical engineering report are satisfied during construction and use of the project, the proposed project will not increase the potential for soil movement. The areas disturbed by construction will be stabilized and should remain stable, subject to the conditions of our geotechnical engineering report. The risk of damage to the proposed development, or to adjacent properties, from soil instability on this site will be minimal, subject to the conditions set forth in our report. The use of the word "minimal" should not be taken to imply that there is no risk, but rather that the risk is low, as construction on, or close to, a slope always involves some risk.

We acknowledge appointment as Special Inspector for this project, and by copy of this letter, request that we be kept informed of the progress of construction so we are able to make the necessary observations, as required by the Seattle DPD, in a timely manner.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.

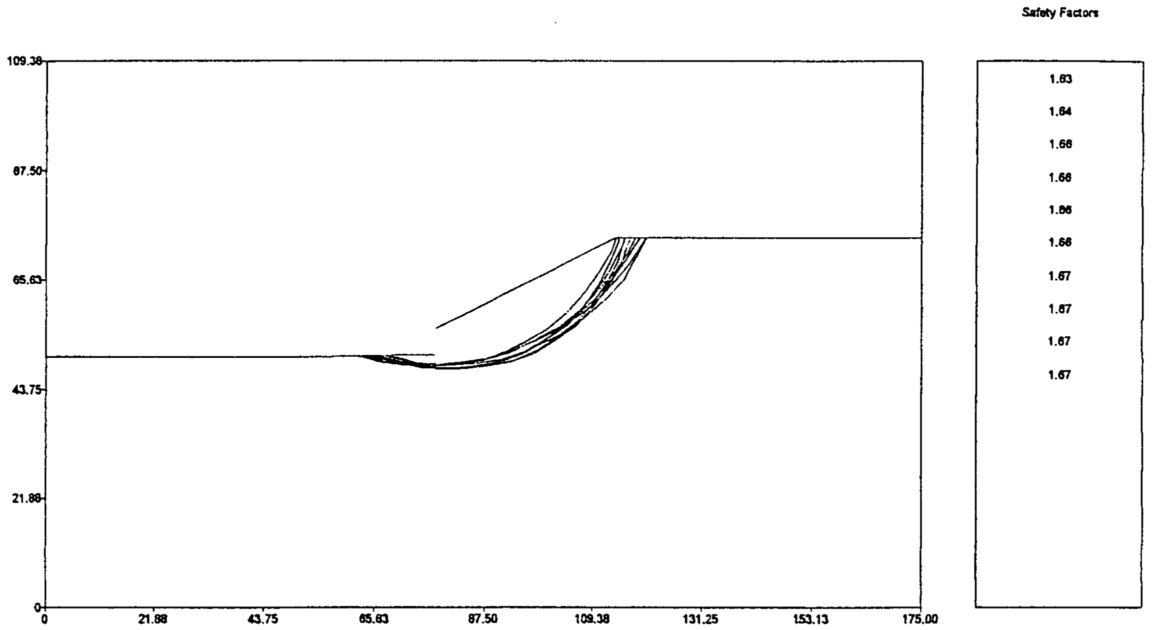
D. ROBERT WARD
STATE OF WASHINGTON
20740
REGISTERED
PROFESSIONAL ENGINEER
3/10/05
EXPIRES 10/21/05

D. Robert Ward, P.E.
Principal

cc: **Fulton Gale Architects** – Tony Gale

DRW: drw

RCLLC 0003414


Safety Factors
109.38
87.50
65.63
43.75
21.88
0
0
21.88
43.75
65.63
87.50
109.38
131.25
153.13
175.00
1.63
1.64
1.66
1.66
1.66
1.66
1.67
1.67
1.67
1.67

STATIC 2:1

rainier 2-1 static
** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION

BOUNDARY COORDINATES

6 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	50.50	50.00	50.50	1
2	50.00	50.50	54.40	50.50	1
3	54.40	50.50	78.00	51.00	1
4	78.00	51.00	78.00	56.00	1
5	78.00	56.00	114.00	74.00	1
6	114.00	74.00	175.00	74.00	1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	140.0	100.0	32.0	0.00	0.0	0

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 0 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	78.00	56.00	78.00	49.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 50 Points Equally Spaced Along The Ground Surface Between X = 43.00 ft.
and X = 70.00 ft.

Each Surface Terminates Between X = 114.00 ft.
and X = 165.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	65.04	50.73
2	69.89	49.50
3	74.85	48.85
4	79.85	48.78
5	84.82	49.30
6	89.70	50.40
7	94.41	52.05
8	98.91	54.25
9	103.11	56.96
10	106.97	60.14
11	110.43	63.75
12	113.44	67.74
13	115.97	72.05
14	116.83	74.00

rainier 2-1 static

*** 1.635 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.49	50.71
2	69.35	49.54
3	74.31	48.91
4	79.31	48.83
5	84.29	49.31
6	89.18	50.34
7	93.93	51.91
8	98.47	54.00
9	102.75	56.58
10	106.73	59.61
11	110.34	63.07
12	113.54	66.91
13	116.29	71.09
14	117.78	74.00

*** 1.641 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.39	50.69
2	68.25	49.53
3	73.21	48.88
4	78.21	48.76
5	83.19	49.16
6	88.11	50.09
7	92.89	51.52
8	97.51	53.45
9	101.89	55.85
10	106.00	58.70
11	109.79	61.97
12	113.21	65.61
13	116.23	69.60
14	118.82	73.88
15	118.87	74.00

*** 1.655 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	65.59	50.74
2	70.33	49.14
3	75.24	48.19
4	80.23	47.90
5	85.22	48.28
6	90.11	49.32
7	94.82	51.00
8	99.26	53.29
9	103.36	56.16
10	107.04	59.54
11	110.24	63.39
12	112.89	67.62
13	114.96	72.17
14	115.51	74.00

*** 1.655 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.69	50.76
2	71.42	49.14
3	76.34	48.20
4	81.33	47.96
5	86.31	48.43
6	91.17	49.59
7	95.82	51.43
8	100.17	53.90
9	104.12	56.96
10	107.60	60.55
11	110.55	64.59
12	112.89	69.01
13	114.59	73.71
14	114.65	74.00

*** 1.656 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.29	50.67
2	67.09	49.27
3	72.02	48.46
4	77.02	48.26
5	82.00	48.67
6	86.89	49.69
7	91.63	51.30
8	96.13	53.47
9	100.34	56.17
10	104.18	59.37

11	107.61	63.02
12	110.56	67.05
13	113.00	71.41
14	114.06	74.00

*** 1.665 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	68.35	50.80
2	73.07	49.15
3	77.98	48.19
4	82.97	47.91
5	87.95	48.34
6	92.83	49.45
7	97.50	51.23
8	101.88	53.64
9	105.88	56.64
10	109.42	60.17
11	112.44	64.15
12	114.87	68.52
13	116.67	73.19
14	116.86	74.00

*** 1.665 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	68.90	50.81
2	73.61	49.14
3	78.52	48.18
4	83.51	47.95
5	88.49	48.45
6	93.34	49.68
7	97.95	51.61
8	102.23	54.19
9	106.09	57.37
10	109.44	61.08
11	112.21	65.24
12	114.35	69.76
13	115.63	74.00

*** 1.666 ***

Failure Surface Specified By 14 Coordinate Points

11	112.44	64.15
12	114.87	68.52
13	116.67	73.19
14	116.86	74.00

*** 1.346 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.39	50.69
2	68.19	49.31
3	73.12	48.46
4	78.11	48.15
5	83.11	48.39
6	88.04	49.18
7	92.87	50.49
8	97.52	52.33
9	101.94	54.66
10	106.09	57.46
11	109.90	60.69
12	113.34	64.32
13	116.36	68.30
14	118.93	72.59
15	119.57	74.00

*** 1.347 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	68.35	50.80
2	73.11	49.27
3	78.03	48.37
4	83.02	48.11
5	88.00	48.51
6	92.90	49.55
7	97.61	51.21
8	102.07	53.47
9	106.20	56.29
10	109.93	59.62
11	113.19	63.41
12	115.94	67.59
13	118.13	72.08
14	118.76	74.00

*** 1.348 ***

rainier 2-1 seismic

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           Y            A     X     I     S            F     T

           0.00     21.88     43.75     65.63     87.50    109.38
X      0.00 +---------+---------+--*------+---------+---------+
            -
            -
            -
            -
            -
      21.88 +
            -
            -
            -
            -
            -
A     43.75 +                      .
            -                    ...
            -                   ...*
            -                  ....*
            -                .......
            -               .......3
X     65.63 +              ........1
            -              .......41
            -             ........20
            -             ........L*  *
            -            .........1
            -            .........31
I     87.50 +            .........52.
            -            ..........13.
            -            ..........41..
            -            ..........831.
            -            ...........071.
            -            .............51..
S    109.38 +            ..............5316.
            -            ...............58316.*
            -             ................57211
            -             ...................73
            -              ....................
            -              ....................
     131.25 +               ...................
            -                ..................
            -                 .................
            -                  ................
            -                   ...............
            -                     .............
F    153.13 +                      ............
            -                        ..........
            -                           .......
            -                              ....
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            -
T    175.00 +                                 *
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